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NAVIGATION ON THE WARRIOR - TOMBIGBEE RIVER SYSTEM

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SYNOPSIS

The Warrior - Tombigbee River System connects one of the greatest industrial areas in the South with one of this Country's leading seaports. It has proven to be one of the important factors in the rapid development of the area. The waterway has successfully withstood heavy competition from other forms of transportation and has become stronger for it. Present commerce has to contend with many difficulties such as small locks, considerable local shoaling, and reaches with narrow and tortuous channels. Modernization of the waterway and the addition of reservoirs in the headwaters for navigation, flood control, water supply, and hydroelectric power will add impetus to the further industrial development of the area and of the State of Alabama.

INTRODUCTION

The Mobile River System which is one of the largest in the southeastern section of the United States drains an area of about 42,000 square miles. It is divided into two branches; the eastern branch being the Alabama and Coosa Rivers with an area of 22,500 square miles and the western branch, the Tombigbee and Warrior Rivers with an area of 19,500 square miles. This river system includes about 12 percent of Mississippi, 60 percent of Alabama, and 9 percent of Georgia. The Mobile River which is formed by the confluence of the Tombigbee and the Alabama is only about 45 miles long. It flows southerly through a wide, low lying, flood plain to enter Mobile Bay at Mobile, Ala.

The Tombigbee River obtains its name from the Indian words "etomba" and "ikibee" which mean "a box" and "maker". This box maker who really was a coffin maker lived on a small creek that joined the river near Jones Bluff in Sumter County, Ala. The route to his home by way of this river was well known to all Indians and thus they gave the stream this name. The river is formed by the confluence of the East and West Forks in northeast Mississippi. The Tennessee River Valley lies to the north and the headwaters of the Yazoo and Big Black Rivers which join the Mississippi River near Vicksburg to the west. The Tombigbee River flows generally in a southeastward direction for about 200 miles to be joined by the Warrior River at Demopolis and then flows southerly for 175 miles to the Mobile River. The upper Tombigbee River has an oval shaped basin having a maximum length of about 195 miles and width of 85 miles. Below Demopolis, the basin is rectangular in shape having a length of 100 miles and width of 45 miles.

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The Warrior River, all of which lies within Alabama, is formed by the juncture of the Mulberry and Locust Forks 20 miles west of Birmingham. The river flows generally southwest for 175 miles to join the Tombigbee. The basin has an area of 6,200 square miles and is roughly triangular in shape with a maximum length of 150 miles and width of 60 miles. It is bounded on the north by the Tennessee River basin and on the east by the Coosa and Cahaba basins. The principal headwater tributaries of the Warrior are the Mulberry, Sipsey, and Locust Forks. The Mulberry Fork which drains an area of 2,366 square miles flows in a southwestward direction until joined by the Sipsey Fork and then flows southward 46 miles to join the Locust Fork. The Locust Fork which also flows southwesterly is the eastern most tributary and drains 1,208 square miles. The total drainage area above the juncture of the Forks is 3,574 square miles or 57 percent of the total area of the Warrior basin.

Description of Waterway

The Warrior and Tombigbee River System which is officially known as the Black Warrior, Warrior, and Tombigbee Waterway consists of the Mobile River above the mouth of Chickasaw Creek which joins the river 3 miles north of Mobile, the Tombigbee River to Demopolis, the Warrior River to the Forks, and 47 miles of the Mulberry Fork, 8 miles of the Sipsey Fork and 24 miles of the Locust Fork. The waterway has a total length of 478 miles, with a maximum continuous length of 448 miles terminating on the Sipsey Fork. Figure 1 shows the location of the waterway and its principal structures. Originally the Warrior River was known as the Tuskaloosa River and the Black Warrior which is the section from Tuscaloosa to the Forks, a distance of 48 miles, the Choctaw River. Today the Black Warrior River is also known as the Warrior, but since the Black Warrior was included in the River and Harbor Acts that authorized the waterway, the Black Warrior has been officially carried as part of the waterway designation. This waterway joins the Intracoastal Waterway at Mobile which connects with the Mississippi River system at New Orleans 135 miles to the west.

Tributary area.- The area tributary to the waterway covers all or part of 15 counties in western Alabama having 25 percent of the area of the State. These counties had a population of 1,215,000 in 1950 which is 40 percent of the population of the entire State. It lies in two distinct physiographic provinces which are separated by the "Fall Line" that crosses the basin in a southeast to northwest direction at Tuscaloosa. The area above this line is known as the Appalachian Plateau Province. It is an upland that is submaturely developed by erosion with elevations ranging from 500 to 2,000 feet above sea level. The plateau is rugged with numerous U-shaped gorges carved 200 to 400 feet below the general level by the many streams. South of the "Fall Line", the Warrior and Tombigbee Rivers flow through the Coastal Plain Province. This plain has low and gently rolling topography with elevations ranging from about 500 feet above sea level at Tuscaloosa, to about 150 feet at Demopolis and sea level at Mobile. The valley varies in width from 1 to 5 miles and generally lies 100 feet below the hilltops. The river has cut a channel 200 to 400 feet wide and about 40 feet deep into the valley floor with some reaches being very tortuous.

The Appalchian Plateau area consists of massive sandstones, subordinate shales, and coal beds of a lower Pennsylvania age. These rocks are gently warped into broad synclinal folds that are broken occasionally by sharper anticlinal folds to expose older Paleozoic rocks. The Coastal Plain consists of variable and poorly consolidated deposits of Upper Cretaceous, Tertiary and Quarternary age. Buhrstone, siltstone, sandstone and poorly indurated clay gravels generally form the ridges and plains and are underlain by chalk, marl, clay and sands. Most of the formations have a prevailing dip to the south and southwest of 20 to 50 feet per mile.

Early History

The first white man to cross this area was De Soto who started his exploration from Tampa Bay in 1540. It was not until 1697, however, that the white invasion got underway. This followed a treaty between the great European powers which designated the area that each would develop. France claimed all the valley of the Mississippi River and as far eastward as the Perdido River. A colony was set up at Mobile in 1711. Negro slaves were introduced into this colony in 1717 and agriculture was undertaken immediately with the principal crops being rice, indigo and tobacco. Trade with the Indians for pelts, however, remained the leading occupation. The British under General Ogelthorpe from Savannah made treaties with the Indians and set up forts in the eastern part of the State in 1739. As a result of the French and Indian Wars that followed all of the area east of the Mississippi was ceded to the British by the treaty of 1763. At the same time, the Spaniards ceded Florida. Settlers from the Atlantic seaboard colonies began to drift into the area in increasing numbers by 1790. Federal troops set up Fort Stoddard which is 40 miles north of Mobile in 1800. An Act of Congress in 1817 divided the Mississippi territory into portions with one having the approximate boundaries of Alabama as they now exist. The State was admitted into the Union on December 14, 1819.

Development of the area then got underway in earnest. Since travel was difficult through the trackless forests, the rivers played a leading part in the movement of people, produce and materials into and out of the area. The St. Stephens Steamboat Company was organized in 1818 followed by the Steamboat Company of Alabama in 1820 and the Mobile Steamboat Company in 1821. Their boats which were of various sizes and shapes began to replace the many flatboats that had been in use. These first steamboats without whistle valves used heavily charged guns to notify the populace of an approach to a landing. It was not until 30 years later that the floating palaces we hear so much about in river lore came into use. Even with steam power, travel was slow. It took these boats from 2 to 3 weeks to go from Mobile to Demopolis, a distance of 220 miles. Side wheel boats navigated the rivers as far as Tuscaloosa for about 4 months out of the year and light-draft stern wheelers for 6 to 9 months.

The first public improvement in the State began in 1831 with the construction of a canal at Muscle Shoals on the Tennessee River. The first railroad, 44 miles long, was completed in 1833 between Tuscumbia and Decatur, two cities which were also on the Tennessee River. The second road which was completed in 1851 was the Western Railroad of Alabama which extended for 161 miles from Selma on the Alabama River to Montgomery and to West Point, Ga. Eight of the first railroads extended into the Tombigbee and Warrior River basin. By 1872, there were 20 different companies operating

over 1,560 miles of track in the State. Birmingham which developed into the center of a great industrial area was incorporated in 1871 with 1,200 inhabitants.

History of Improvement

The first project for the improvement of the Tombigbee River was adopted in 1871. This provided for 3-foot year-around navigation between Mobile and Demopolis by the construction of wing dams, by the removal of snags and wrecks and by widening the channel. The coal fields of northern Alabama through which the Warrior River flows were opened up in about 1870. Since there was the possibility of cheap transportation of coal to the Gulf by water, Congress approved in 1874 the first Act authorizing an examination and survey of the river from the mouth to the juncture of the Forks. Only partial examination and survey was made at that time because of inadequate funds, but sufficient information was obtained to serve as the basis for a plan of improvement of the river below Tuscaloosa. Work began in July 1875 on the project that was to provide an 80-foot wide channel 4 feet deep at low water. This was to be accomplished by the removal of snags, overhanging trees, and the lowering of bars by the construction of temporary dams, wing dams, dredging and blasting. The work continued until 1887 at a total cost of about $99,000 and included improvements on the Tombigbee River to Columbus, Miss.

Prior to this time very little had been done about improving the river above Tuscaloosa. On March 3, 1879, Congress approved an Act providing for a survey of this reach of the river. The report that was submitted gave sufficient evidence as to the feasibility of constructing a series of locks and dams to overcome the many rock shoals and other obstacles to navigation. After 8 years of study and investigation, a project was adopted in 1887 that extended navigation to Daniels Creek 14 miles above Tuscaloosa by a slackwater system of 5 locks with fixed dams and with a minimum navigable depth of 6 feet. Construction of the first lock on the river began in the spring of 1888. This lock was located at Tuscaloosa and was known at the time of its replacement in 1940 as Lock No. 10. By November 1895, 3 locks and dams had been completed and were open to traffic. On January 12, 1896, the first tow of coal, consisting of 1 barge, started down the river. It reached Mobile 18 days later. This movement was the subject of town meetings and an ovation at each town it passed, because it was the first sign of what was believed would be the source of prosperity for the Warrior basin.

Advocates of water transportation encouraged by the success of this first development, secured from Congress, within a few years, an authorized 6-foot navigable depth channel from the mouth to the coal fields. By 1908, 4 more locks and dams had been completed and 3 were under construction. By 1915, 13 locks and dams had been completed and opened to traffic on the Warrior River, and 4 on the Tombigbee River below Demopolis. They provided a 6-foot channel from the Gulf of Mexico to Nichols Shoals on the Locust Fork 424 river miles above Mobile and to Sanders Shoals near Cordova on the Mulberry Fork 443 miles above Mobile. The series of 17 locks had an aggregate lift of 244 feet. The total construction cost through 1915 amounted to a little over $9,000,000 of which $7,000,000 was expended on the improvement of the Warrior River proper. In the construction of the dams, provision was made for temporary flash boards to be used during low-water stages. In 1918 and 1919, however, the temporary flash boards were replaced by permanent construction resulting in an all-year channel depth of 8 feet.

The project has now been modified so that a 9-foot navigable depth is available where practical. Flashboards were again added to Dams 1 through 9 and the crests of Dams 13 through 16 were raised 1 foot. A cut-off 1.4 miles long was made about 20 miles below Lock 1 in 1938 to reduce the river distance by 9 miles and also in 1938 crest gates were added at Lock 17 to raise that pool 9 feet. The Tuscaloosa Lock and Dam was constructed in 1940 to replace Locks 10, 11, and 12, which were the first locks to be opened in 1895. The total cost for construction up to 1945 was $16,944,000. The River and Harbor Act of 2 March 1945 authorized the construction of a new lock and dam near Demopolis to replace existing Locks 4, 5, 6, and 7. This project estimated to cost $20,397,000 is now under construction by the Corps of Engineers and is presently scheduled for completion by January 1, 1956. There is authorized and planning is now underway for a project known as the Warrior Lock and Dam to replace Locks 8 and 9. Preliminary planning studies are also underway for the modernization of the Tombigbee River below Demopolis by a single project near Lock 1 which will replace Locks 1, 2, and 3. The total cost for construction on the waterway to 30 June 1953 was $25,318,000.

Waterway Structures

The original locks of this waterway all had chamber widths of 52 feet and available lengths of 282 to 287 feet. Lifts varied from 8.5 to 14 feet at all except the two uppermost locks. The lower of these had a 21-foot lift and the uppermost known as Lock 17 had 2 chambers in tandem each with a 31.5-foot lift. The top of the lockwalls were about 11 feet above the fixed crest of the dams. All of the locks were constructed of concrete except the four earliest ones which were of sandstone masonry. A depth of 8.5 feet was provided over the lock sills. All of the gates and valves were hand-operated except at Lock 17 which used electric power. Motors have recently been added at most of the locks to operate the miter gates, but the valves are still hand-operated. Principal details of these locks are given in table 1.

The first three dams which were located near Tuscaloosa were timber cribs filled with stone and the fourth was stone. As the development proceeded, concrete was adopted for the dams with adequate foundation conditions and timber cribs filled with stone for those with poor conditions. Typical sections of these dams are shown in figure 2. All dams were originally of the free overflow type with crests having lengths ranging from 300 to 1,170 feet. Lock 1 was modified by the addition of 3-foot high movable A-frames set on a lowered crest. The crest gates added to the dam at Lock 17 in 1938 are vertical-lift gates 22 of which are 13.5 feet high and 52 feet long and 2 are 13.5 feet high and 24 feet long. The crest of the dam was lowered 3 feet to compensate for the discharge capacity lost by the addition of piers which support the gates and operating bridge. The principal features of the dams are also given in table 1.

Waterway modification.- The first major replacement was the new lock and dam at Tuscaloosa. This new lock differs from the older locks in that it has a chamber 95 feet wide and 460 feet long. The lift is 30 feet and the depth over sills 10.8 feet. The concrete dam has a free overflow fixed crest 780 feet long. The lock is hydraulically operated using its own water turbines for power. Two of the pumps are direct gear connected to the turbines and the third is gasoline engine driven when the head differential is less than 7 feet. The Demopolis Lock and Dam will have a lock chamber 110 feet wide

and 600 feet long, a lift of 40 feet, and a 13-foot depth over the sills. It will be hydraulically operated with variable volume Vickers Pumps driven by electric motors. The dam is of the fixed-crest free overflow type having a length of 1,485 feet. The reservoir covering 10,000 acres will extend 70 miles to Lock 8 on the Warrior River and 65 miles up the Tombigbee. The Warrior Lock and Dam being considered to replace Locks 8 and 9 will be located at a large bend of the river below Lock 7. The lock will have the same chamber dimensions as the Demopolis Lock, will have a lift of 22 feet, and will be in a cutoff to shorten the river distance 5 miles. The spillway section of the dam will be gated and the remainder an earth fill. The reservoir will extend 80 miles to the Tuscaloosa Lock and Dam and will increase the depth on the lower sill of that lock about 2 feet.

Waterway Use

Commerce.- There has been a steady growth of commerce on this waterway. The earliest report of traffic indicated that 2,600 tons moved in 1893. Considerably more traffic than this was known to be moving on the river especially along the lower Tombigbee, but no records are available. A total of 539,000 tons were reported as moving over the waterway in 1909 with 11 locks completed and in 1916 the first full year after completion of the slackwater route, there was reported 467,000 tons of freight and 12,250 passengers. Traffic amounted to 601,000 tons of freight and 3,760 passengers by 1919, and 1,939,000 tons of freight and 680 passengers by 1929. The passenger traffic disappeared shortly thereafter with the advent of new highways and the development of other faster and far reaching forms of transportation. During the depression years, commerce fell to a low of 958,000 tons in 1932 but with the revival of industry, commerce again increased to 2,296,000 tons by 1941. World War II with the demand for speed and the adjustment of industry to a war economy caused commerce to again fall off. The year 1946 was a year of readjustment back to a peace time economy which resulted in the movement of only 1,372,000 tons on the waterway. Since then it has steadily increased to a maximum of 2,713,000 tons in 1951. The growth of commerce moved over this waterway since 1900 is shown by the upper curve in figure 3.

In the early years of the waterway, logs, lumber, cotton, grain and general merchandise were the principal cargo. In 1919, logs and lumber amounted to 57 percent of the traffic, coal 22 percent, and sand and gravel 15 percent. The movement of structural and railroad steel was inaugurated in December 1919. Commerce in 1924 consisted of 44 percent logs and lumber, 16 percent coal, 13 percent sand and gravel, 3 percent iron ore, and 5 percent iron and steel products. The movement of logs and lumber amounted to only 32 percent of the total commerce in 1929 with sand and gravel amounting to 21 percent, stone 16 percent, iron and steel products 13 percent, coal 5 percent, sugar 3 percent, iron ore 3 percent, and refined petroleum products 2 percent. The commerce of 1951 was made up of 28 percent limestone which is used in the making of cement, 14 percent refined petroleum products, 14 percent iron and steel products, 10 percent coal, 9 percent logs, pulpwood and lumber, 8 percent iron ore, and 8 percent crude petroleum that is produced mostly in the Gilbertstown oil field located in southwest Alabama. A comparison of the volume of total and principal commodities moved since 1929 is shown in figure 4.

It is interesting to note that the upbound cargo did not vary much from year to year until after World War II when this volume doubled. Downbound

traffic fluctuated considerably depending upon economic conditions. During the period 1922 to 1946 the downstream movement exceeded the upstream movement a maximum of about nine times in 1929 and a minimum of four times in 1922. At present the downbound traffic is only about double the upbound traffic. The total tons moved upstream and downstream are shown by the lower curves in figure 3.

Floating plant.- As has been pointed out previously, all early traffic was carried by steamboats but there is no record of the number plying the river. The opening of the coal fields in 1870 initiated the use of barges. There was reported in operation in 1919, 2 packet boats, 5 self-propelled steel barges, 11 steam stern-wheel towboats, 9 gasoline stern-wheel towboats, 7 steam screw-propellor tugs, and 5 gasoline screw-propellor tugs. There were also many barges.

The Federal Control Act of March 21, 1918, authorized the Director General of Railroads to spend the necessary funds for the purchase, construction, utilization, and operation of transportation facilities on inland waterways. Practically all privately owned vessels on the waterways were commandeered at that time and a program of construction of new floating plant was initiated. The Transportation Act of 1920 transferred the functions of the Railroad Administration to the Secretary of War who operated the Federal property as the Bureau of Inland and Coastwise Waterways Service. An Act of Congress dated June 3, 1924 created the Inland Waterways Corporation to replace this Bureau. It was operated under the supervision of the Secretary of War until 1939 when it was transferred to the Department of Commerce. This agency when first formed initiated the use of the self-propelled barge and the towboat with a fleet of 2 to 7 barges. The Corporation operated 4 twin-screw tunnel-type steam towboats, 1 self-propelled barge and 52 steel barges on this waterway in 1929. At the time of its sale last year, 1 towboat and 40 barges were in service between Port Birmingham and New Orleans. Under private ownership, it will continue to provide common-carrier service.

In about 1927, the Tennessee Coal and Iron Co., a manufacturer of iron and steel products with mines, furnaces, and mills in the Birmingham area initiated their own water service. They had been a big customer of the Government line and had learned of the economies of water transportation. At the outset their fleet consisted of 2 leased towboats and 31 steel barges. They now operate 6 modern deisel towboats, 3 harbor craft, and 88 barges.

There were 11 companies operating in 1929 having a total of 19 towboats, 10 of which were steam powered, and 125 barges of which 42 were of wood. Today there are 21 companies on the river operating 43 towboats having a total of 17,600 HP ranging from 100 to 1,300 HP and 204 registered barges. There are 4 twin-screw tunnel-type deisel towboats of 1,300 HP capable of pushing up to 11 barge tows. There are only a few steam powered and only 1 steam sternwheel towboat on the river. The latter is the towboat "Mixon" operated by the Corps of Engineers for moving operational plant to various points on the river.

The equipment now used on the waterway has been sized to fit the present locks and is somewhat smaller than is found on other waterways. Barges to be handled in fleets are 25 feet wide and 140 feet long with a capacity of 500 tons at drafts of 7.5 feet. The large towboats have also been built to this size drawing about 7.5 feet so that they can be fitted into a fleet of barges. The larger barges found on other waterways are coming more into use today, but they are usually handled in tows of 1 to 3 barges.

Terminals.- There are 17 terminals along this waterway. All are now owned and operated by private companies. Most terminals have been set up to handle specialized cargoes such as oil, coal, logs, etc. The principal terminal on the waterway is located at Port Birmingham on the Locust Fork. The Warrior and Gulf Navigation Co. operates a large electric travelling overhead gantry with a 15-ton capacity at this port for the transfer of all commodities to a railroad siding. The Inland Waterways Corp. which has now been purchased by a private company, also has a large storage warehouse and a stiff-leg derrick for the handling of general cargoes there. Oil handling and storage facilities are also in the area. The Warrior Terminal Railroad which was purchased by the Inland Waterways Corp. in 1926 is about 27 miles long and connects the port with all rail lines at Birmingham. It was also sold to private interests along with the Government water line.

Navigation of the Waterway

The existing project for the waterway provides for a 200-foot wide channel with a 9-foot controlling depth where practical. There are several reaches where less than project width is found at low-water. Also, many bars form rapidly after each rise in the river to produce less than project depths. The worst shoaling conditions occur in the upper reaches of the pools of Locks 2, 3, 4, and 5. The narrowest and also the most tortuous stretch of river is found in the pools of Locks 6 and 7 with some reaches being only 175 feet wide and some bends having a radius of only 350 feet. Above Tuscaloosa, the channel is comparatively straight with easy curves and 500 feet wide up to the juncture of the Forks where it again narrows to about 250 feet. There are no channel markers on this river nor has a recent and complete hydrographic survey been made. Navigation depends completely upon the knowledge and skill of the river pilots. Radio has in recent years helped these pilots to locate each other so that the widest passing places can be selected. Radar is now in a very preliminary experimental stage.

There are 18 bridges over the waterway with horizontal clearances ranging from 130 to 300 feet. Seven of these bridges are of the vertical-lift type, one is of the swing type and ten are fixed. Vertical bridge clearances are sufficient for high-water navigation at all except those at miles 427.9 and 428.0 on the Mulberry Fork. These bridges tie up navigation for several days during highwater. The rapid fluctuation of river stages in this reach create very high velocities so it is doubtful whether navigation could proceed if clearance were available. Data on all of the bridges crossing the waterway are shown in table 2.

The Warrior and Tombigbee Rivers are subject to considerable variation in stages. The river rises as much as 55 feet at Tuscaloosa, 57 feet at Demopolis and 36 feet at Lock 1. The rate of rise at Tuscaloosa is very rapid usually being about 25 feet per day, but an extreme of 40 feet has been recorded. All locks except Lock 17 are designed to flood when the river stage is at about 11 feet above the upper pool. At this stage there is a depth of 11 feet over the crest and a swell-head of about 1 foot exists thus enabling the tows to proceed over the dam. Some difficulty is experienced by the smaller tows with low powered tugs when they hit this swell-head just after some of the locks are flooded. They usually come to a stop at this point because they do not have the momentum to carry through the swift water and their propellors are not turning fast enough to produce forward driving power. If a line from another tug is not available to pull them, they have to tie up until a favorable stage prevails.

Tows navigate on the waterway at all stages. During high water, the pilots seek out the slower currents close to the banks. Tows bound in either direction sometimes have to be broken making several trips with a few barges at a time through critical reaches. Tows proceeding downstream take full advantage of the current by flanking the stream with steerage-way only maintained by the towboat. During low stages, tows have to be handled around many bends that are too sharp or narrow for steering. This maneuver consists of easing a bow corner of the tow into the bank, pivoting until the stern eases to the same bank, then swinging the bow into the stream and moving forward. This sometimes has to be performed several times until the tow has cleared the bend. Much time is lost by the larger tows in this operation.

Tows moving on the waterway consist of 1 to 11 barges with the larger ones averaging about 9 barges. The smaller tows are usually made up of the larger barges with special cargo such as oil, gasoline, limestone, etc. The size of the tow is usually predicated upon maneuverability through the small locks. The largest tow now moved on the river consists of 11 barges. It is made up with 3 barges abreast and 4 barges in length. Since the barges and the towboat are generally of the same size, the towboat is placed between the stern barges for protection during the navigation of sharp bends. Some efficiency is thus sacrificed. The smaller tows average from 3.5 to 8.0 knots, depending on river stages, the draft of barges, and the amount of other traffic to be passed. The larger tows average 2.0 to 5.0 knots making the round trip from Mobile to Port Birmingham in about 12 days. The greatest delay to the larger tows occurs at the locks. The tow is broken into units of 4 barges to be locked through. Tow hauling equipment available at all except the Tuscaloosa Lock is used to pull the upbound units from the lock while downbound units are flushed out. With present equipment, it takes about 30 to 45 minutes per lockage. Large tows with 8 to 11 barges usually require 2.0 to 2.5 hours to clear a lock. The total time per round trip spent by a large tow at the locks is about 70 hours or about 3 days of their round trip time.

Future of the Waterway

This waterway has proven to be an asset to the State of Alabama and will continue to be an important factor in the industrial growth of the Warrior Valley. Commerce on the waterway in recent years has about attained earlier estimates and would no doubt have surpassed this amount if navigation conditions had been improved. An estimate of 2,900,000 tons by 1950 was made in a report contained in House Document No. 56, Seventy-third Congress, first session submitted in 1930. Within a short time, iron ore in large quantities will be brought into the Port of Mobile from Venezuela destined for the mills at Birmingham. A goodly share of this ore will be moved by water which has proven to be an economical form of transportation for such a bulk commodity. There will also be completed large steam generating power plants near the coast that will use large quantities of coal. The combination of full cargoes in both directions will effect material savings in transportation charges. It is possible that as much as 5,000,000 tons will move over the waterway when the modernization program is well underway.

Modernization of the existing project by replacing the present locks with fewer large locks will greatly reduce the operating time of most tows. Deepening of the pools will also permit faster and safer operating speeds and will reduce the amount of maintenance dredging. When modernization of the waterway is assured, there will be changes made in operators' floating equipment.

Larger barges 35 feet wide and 150 feet long with capacities of about 1,000 tons will come more into general use. Likewise, towboats 35 feet wide with better steering and handling properties for the larger tows, will be constructed. However, practically all of the small sized locks will have to be replaced before large investments are made in this type of equipment.

Future development of the basin. - The basin with all of its natural resources for industrial development has a very bright future. However, water is its present greatest need. Studies are now being made for the development of reservoirs in the headwaters, that is, on the Sipsey, Mulberry, and Locust Forks for the storage of flood waters, the generation of hydroelectric power, and the maintenance of a greater minimum low-water flow to meet future lockage and water supply needs and to reduce pollution. This development will assure a continued industrial growth in the area. The value of water has been fully realized by leaders in the area. They have organized and are actively promoting the development of this resource which has been so abundantly provided. We can therefore look forward to many changes that will take place for the betterment of the Tombigbee - Warrior River system within the next decade.

Table 1

Pertinent Features of Locks and Dams on the Waterway

Lock	Distance[1] (miles)	Nearest town in Alabama	Distance (miles)	Lock dimensions - feet: Length	Width	Lift	Depth on sills	Type lock construction	Character of foundation	Dam: Kind	Length (feet)	Type construction	Date opened to Navigation	Date completed	Actual cost of lock and dam
1	101.6	Salitpo	5	281.9	52	12	8.0[2]	concrete	soft rock	fixed	500	concrete	Sept. 6, 1908	1909	$560,300
2	172.6	Pennington	3	286.0	52	9	10.0	do	hard clay	do	500	timber[3]	Nov. 1, 1914	1915	560,100
3	194.6	Whitfield	9	286.0	52	10	9.0	do	do	do	500	do	Sept. 21, 1914	1915	609,600
4	221.6	Demopolis	1	285.6	52	10	9.0	do	do	do	500	do	Dec. 1, 1908	1908	479,000
5	236.6	Greensboro	17	285.6	52	10	9.0	do	do	do	300	do	Sept. 1, 1908	1908	501,000
6	257.1	Sawyerville	6	285.6	52	10	9.0	do	piles	do	299	do	Oct. 1, 1908	1908	443,000
7	272.6	Eutaw	6	284.7	52	10	9.0	do	do	do	300	do	Nov. 7, 1903	1903	225,600
8	288.6	Akron	3	284.7	51.7	10	9.0	do	do	do	340	do	Jan. 1, 1903	1903	212,400
9	305.6	Moundville	7	284.7	52	11	9.0	do	do	do	300	do	Jan. 1, 1903	1902	202,400
Tuscaloosa	351.3	Tuscaloosa	-	460.0	95	30	10.8	do	hard blue shale	do	700	concrete	Aug. 29, 1939	1940	4,450,900
10	352.6	Tuscaloosa	-	286.6	52	9.9	8.5	stone	hard sandstone	do	-	timber[3]	-[4]	1895	244,500
11	353.1	Tuscaloosa	-	286.0	52	8.5	8.5	do	do	do	-	do	-[4]	1895	170,000
12	353.6	Tuscaloosa	1	286.2	52	10.5	8.5	do	do	do	-	do	-[4]	1895	160,500
13	360.6	Peterson	3	285.5	52	11	10.7	do	do	do	640	stone	July 4, 1905	1905	203,700
14	364.1	Peterson	7	282.1	52	14	9.5	concrete	do	do	930	concrete	March 29, 1910	1910	414,700
15	370.6	Northport	20	282.1	52	14	10.0	do	do	do	870	do	May 2, 1910	1910	430,200
16	377.1	Adger	21	285.5	52	21	9.5	do	do	do	1045	do	Jan. 1, 1915	1915	520,900
17	378.6	Adger	20	285.5	52	72[5]	9.5	do	do	gated[6]	1170	do	May 13, 1915	1915	3,424,900

(1) Mileage from foot of Government St., Mobile, Ala.

(2) River affected by tides below lock. Depth of 9 feet 91 percent of time, extreme low 6.9 feet.

(3) Timber crib filled with stone.

(4) Abandoned in 1940.

(5) Double lock. Lift of 63 feet increased to 72 feet in 1938

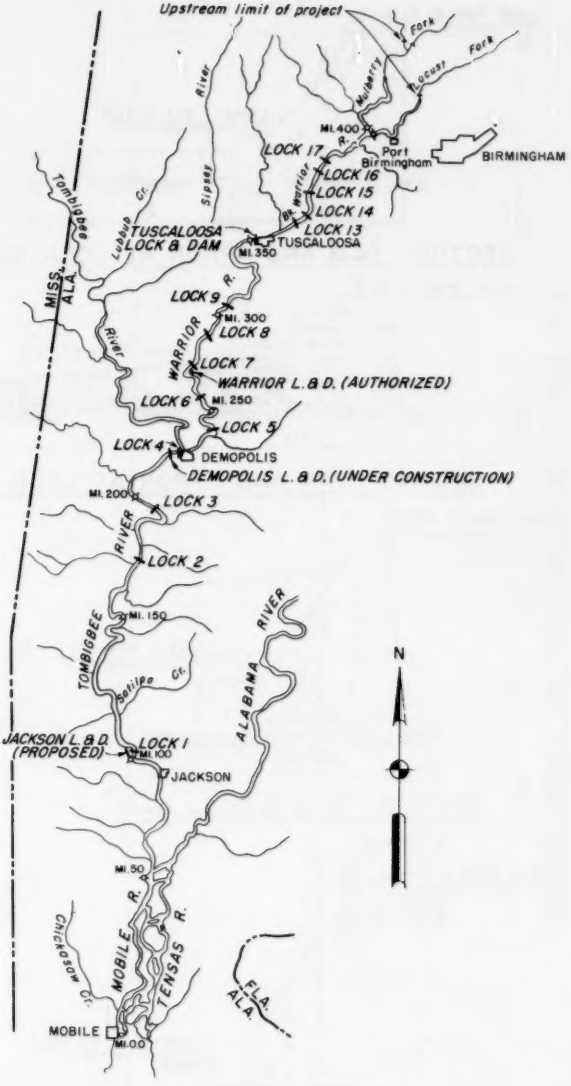
(6) Gates added in 1938

Table 2

Bridges Over Waterway

Location miles above Mobile	River crossed	Owner and purpose	Date built	Type	Clearance - feet	
					Horizontal	Vertical*
13.9	Mobile	L & N RR.	-	Swing	146.7	5.3
90.1	Tombigbee	Sou. RR.	1950	Lift	300.0	52.0
92.1	Tombigbee	Ala.Hwy Dept.	-	Lift	200.0	52.0
169.2	Tombigbee	Ala.Hwy Dept.	-	Fixed	150.0	52.0
177.3	Tombigbee	M & B RR.	-	Lift	150.0	-
205.8	Tombigbee	Ala.Hwy Dept.	-	Lift	150.0	52.0
223.9	Warrior	Ala.Hwy Dept.	-	Fixed	150.0	52.0
224.0	Warrior	St. L & SF RR.	-	Lift	176.0	46.0
275.9	Warrior	Ala.Hwy Dept.	-	Fixed	150.0	52.0
278.6	Warrior	A.G.S.RR.	1871	Lift	155.0	72.0
332.8	Warrior	Ala.Hwy Dept.	-	Fixed	200.0	52.0
350.8	Warrior	G M & O RR.	1898	Fixed	260.0	45.0
350.9	Warrior	Ala.Hwy Dept.	1923	Lift	175.5	40.9
404.3	Locust Fork	Ala.Hwy Dept.	1915	Fixed	200.0	21.5
424.4	Mulberry Fork	Sou. RR.	-	Fixed	130.0	14.0
427.9	Mulberry Fork	Ala.Hwy Dept.	-	Fixed	235.0	30.0
428.1	Mulberry Fork	St. L & SF RR.	-	Fixed	125.0	12.0
433.7	Mulberry Fork	Ala.Hwy Dept.	1942	Fixed	200.0	40.0

* Distance above high water

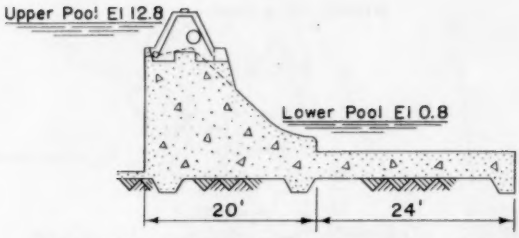


BLACK WARRIOR AND WARRIOR RIVERS, ALA.

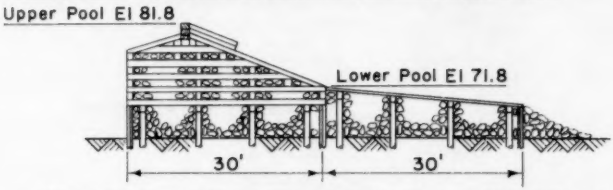
SCALE IN MILES

10 0 10 20 30 40

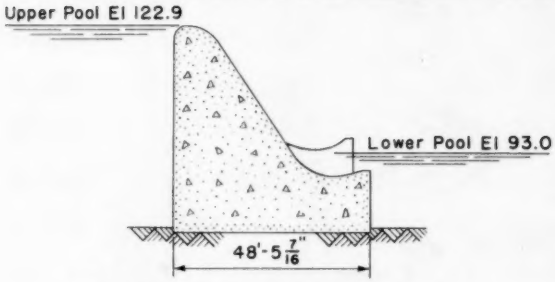
Figure 1



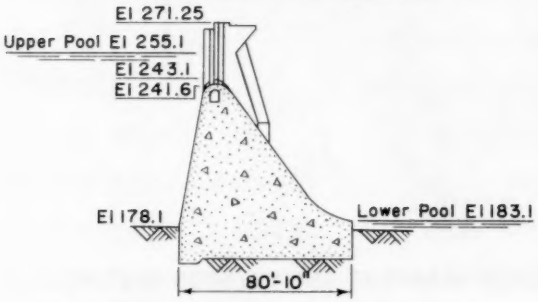
SECTION - DAM AND APRON AT LOCK NO. 1



SECTION - DAM AND APRON AT LOCK NO. 8

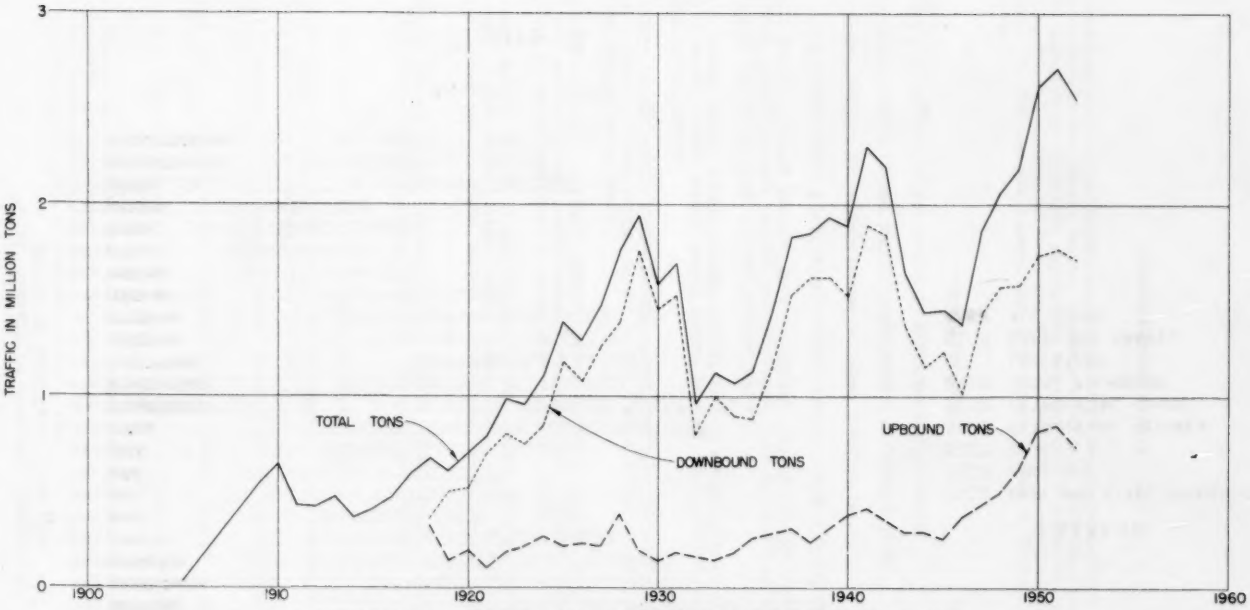


SECTION - TUSCALOOSA DAM



SECTION - DAM AT LOCK NO. 17

Figure 2



TONNAGE MOVED ON WATERWAY, 1906 TO 1952 INCL.

Figure 3

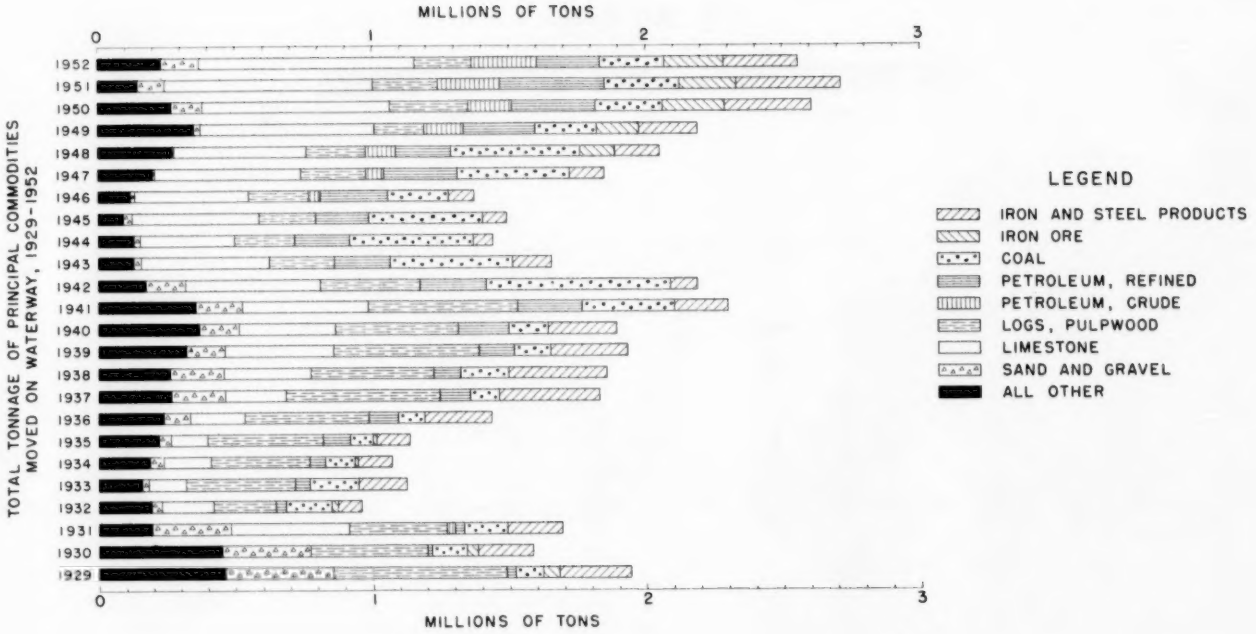

TOTAL TONNAGE OF PRINCIPAL COMMODITIES MOVED ON WATERWAY, 1929-1952
MILLIONS OF TONS
0
1
2
3
1952
1951
1950
1949
1948
1947
1946
1945
1944
1943
1942
1941
1940
1939
1938
1937
1936
1935
1934
1933
1932
1931
1930
1929
LEGEND
IRON AND STEEL PRODUCTS
IRON ORE
COAL
PETROLEUM, REFINED
PETROLEUM, CRUDE
LOGS, PULPWOOD
LIMESTONE
SAND AND GRAVEL
ALL OTHER

Figure 4

PROCEEDINGS-SEPARATES

The technical papers published in the past twelve months are presented below. Technical-division sponsorship is indicated by an abbreviation at the end of each Separate Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. For titles and order coupons, refer to the appropriate issue of "Civil Engineering" or write for a cumulative price list.

VOLUME 79 (1953)

MARCH: 176(SA), 177(EM), 178(HY), 179(EM), 180(HY), D-123(HY), D-126(ST), D-128(ST).

APRIL: 181(WW), 182(ST), 184(HY), 185(EM), 186(HY), 187(ST), 188(HY), D-135(HY), D-136(ST).

MAY: 189(HY), 190(HY), 191(CP) & (AT), 192(SM), 193(HY), D-129(PO), D-138(CP), D-145(ST).

JUNE: 194(CP) & (AT), 195(SM), 196(CP) & (AT), 197(HY), 198(ST), 199(EM), D-134(HY), D-141(HY).

JULY: [a] 200(SM)[b], 201(ST)[b], 202(EM)[b], 203(SM)[b], 204(AT)[b], 205(EM)[b], 206(ST)[b], 207(SA)[b], 208(SA)[b], 209(ST)[b], 210(SU)[b], 211(EM)[b], 212(SU)[b], 213(IR)[b], 214(HW)[b], 215(SM)[b], 216(ST)[b], 217(ST)[b], 218(ST)[b], 219(ST)[b], 220(SM)[b], 221(HW)[b], 222(SM)[b], 223(EM)[b], 224(EM)[b], 225(EM)[b], 226(CO)[b], 227(SM)[b], 228(SM)[b], 229(IR)[b].

AUGUST: 230(HY), 231(SA), 232(SA), 233(AT), 234(HW), 235(HW), 237(AT), 238(WW), 239(SA), 240(IR), 241(AT), 242(IR), 243(ST), 244(ST), 245(ST), 246(ST), 247(SA), 248(SA), 249(ST), 250(EM)[c], 251(ST), 252(SA), 253(AT), 254(HY), 255(AT), 256(ST), 257(SA), 258(EM), 259(WW).

SEPTEMBER: 260(AT), 261(EM), 262(SM), 263(ST), 264(WW), 265(ST), 266(ST), 267(SA), 268(CO), 269(CO), 270(CO), 271(SU), 272(SA), 273(PO), 274(HY), 275(WW), 276(HW), 277(SU), 278(SU), 279(SA), 280(IR), 281(EM), 282(SU), 283(SA), 284(SU), 285(CP), 286(EM), 287(EM), 288(SA), 289(CO).

OCTOBER: [d] 290(all Divs), 291(ST)[c], 292(EM)[c], 293(ST)[c], 294(PO)[c], 295(HY)[c], 296(EM)[c], 297(HY)[c], 298(ST)[c], 299(EM)[c], 300(EM)[c], 301(SA)[c], 302(SA)[c], 303(SA)[c], 304(CO)[c], 305(SU)[c], 306(ST)[c], 307(SA)[c], 308(PO)[c], 309(SA)[c], 310(SA)[c], 311(SM)[c], 312(SA)[c], 313(ST)[c], 314(SA)[c], 315(SM)[c], 316(AT), 317(AT), 318(WW), 319(IR), 320(HW).

NOVEMBER: 321(ST), 322(ST), 323(SM), 324(SM), 325(SM), 326(SM), 327(SM), 328(SM), 329(HW), 330(EM)[c], 331(EM)[c], 332(EM)[c], 333(EM)[e], 334(EM), 335(SA), 336(SA), 337(SA), 338(SA), 339(SA), 340(SA), 341(SA), 342(CO), 343(ST), 344(ST), 345(ST), 346(IR), 347(IR), 348(CO), 349(SM), 350(HW), 351(HW), 352(SA), 353(SU), 354(HY), 355(PO), 356(CO), 357(HW), 358(HY).

DECEMBER: 359(AT), 360(SM), 361(HY), 362(HY), 363(SM), 364(HY), 365(HY), 366(HY), 367(SU)[e], 368(WW)[e], 369(IR), 370(AT)[e], 371(SM)[e], 372(CO)[e], 373(ST)[e], 374(EM)[e], 375(EM), 376(EM), 377(SA)[e], 378(PO)[e].

VOLUME 80 (1954)

JANUARY: 379(SM)[e], 380(HY), 381(HY), 382(HY), 383(HY), 384(HY)[e], 385(SM), 386(SM), 387(EM), 388(SA), 389(SU)[e], 390(HY), 391(IR)[e], 392(SA), 393(SU), 394(AT), 395(SA)[e], 396(EM)[e], 397(ST)[e].

FEBRUARY: 398(IR)[f], 399(SA)[f], 400(CO)[f], 401(SM)[f], 402(AT)[f], 403(AT)[f], 404(IR)[f], 405(PO)[f], 406(AT)[f], 407(SU)[f], 408(SU)[f], 409(WW)[f], 410(AT)[f], 411(SA)[f], 412(PO)[f], 413(HY)[f].

MARCH: 414(WW)[f], 415(SU)[f], 416(SM)[f], 417(SM)[f], 418(AT)[f], 419(SA)[f], 420(SA)[f], 421(AT)[f], 422(SA)[f], 423(CP)[f], 424(AT)[f], 425(SM)[f], 426(IR)[f], 427(WW)[f].

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a. Beginning with "Proceedings-Separate No. 200," published in July, 1953, the papers were printed by the photo-offset method.
b. Presented at the Miami Beach (Fla.) Convention of the Society in June, 1953.
c. Presented at the New York (N.Y.) Convention of the Society in October, 1953.
d. Beginning with "Proceedings-Separate No. 290," published in October, 1953, an automatic distribution of papers was inaugurated, as outlined in "Civil Engineering," June, 1953, page 66.
e. Discussion of several papers, grouped by divisions.
f. Presented at the Atlanta (Ga.) Convention of the Society in February, 1954.

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1954-2

SOIL MECHANICS AND FOUNDATIONS DIVISION

NEWSLETTER

March, 1954

For the information of ASCE members whose primary professional interest is in soil mechanics or foundation engineering. Prepared by the Executive Committee of the Soil Mechanics and Foundation Division.

ASCE

SOIL MECHANICS AND FOUNDATIONS DIVISION

NEWSLETTER

March 1954

This is the first issue of a brief bulletin to be published quarterly under the sponsorship of the Soil Mechanics and Foundations Division of the American Soc'ety of Civil Engineers.

The Newsletter is intended primarily for those members of the Society who have chosen the Soil Mechanics and Foundations Division as their first interest; and regular distribution of its issues will be based on registration in that Division. Requests from other Society members will of course be honored as far as possible.

The objectives of the Newsletter are to keep Division members informed about Society and Division activities, to publish items of general interest to the Division that might not otherwise be widely or promptly distributed, and to promote interest and participation in the work of the Division and, through it, of the Society.

Howard P. Hall, Editor
Department of Civil Engineering
Northwestern University
Evanston, Illinois

MEMBERS OF THE EXECUTIVE COMMITTEE
SOIL MECHANICS AND FOUNDATIONS DIVISION

Arthur Casagrande, Chairman
Division of Applied Science
Pierce Hall, Harvard University
Cambridge 38, Massachusetts

Contact Member for Committees on Earth Dams and Session Programs.

Hibbert M. Hill
Northern States Power Company
15 South 5th Street
Minneapolis, Minnesota

Contact Member for Committees on Cooperation with Local Sections and Publications.

Ralph B. Peck
113 Talbot Laboratory
University of Illinois
Urbana, Illinois

Contact Member for Committees on Glossary and Engineering Geology.

Willard J. Turnbull
Soils Division, Corps of Engineers
Waterways Experiment Station
Vicksburg, Mississippi

Contact Member for Committees on Grouting and Pavement Foundations.

Stanley D. Wilson
c/o W. L. Shannon
1055 Stuart Building
Seattle, Washington

Contact Member for Committee on Sampling and Testing and the United States National Council on Soil Mechanics and Foundation Engineering.

Jorj O. Osterberg, Secretary
Department of Civil Engineering
Northwestern University
Evanston, Illinois

DIVISION ACTIVITIES

A summary of the official activities of the Soil Mechanics and Foundations Division during the past year follows:

(1) Arthur Casagrande succeeded Hibbert M. Hill as Chairman of the Executive Committee, effective at the October, 1953, meeting of the Society. Raymond F. Dawson (Bureau of Engineering Research, University of Texas, Austin, Texas) resigned from his duties on the Executive Committee to accept a Directorship of the Society. He has been replaced by Stanley D. Wilson. Jorj O. Osterberg succeeded Hamilton Gray (Dept. of Civil Engineering, University of Maine, Orono, Maine), as the latter concluded seven years of service as Secretary of the Executive Committee.

(2) The Committee on Soil Mechanics Bibliography (Chairman, W. G. Holtz, Earth Materials Laboratory, U. S. Bureau of Reclamation, Denver, Colorado) completed its task of compiling a list of fifty outstanding references on the subjects of soils and foundations. The Committee's report was accepted and the Committee dissolved.

(3) The Committee on Glossary of Terms and Definitions in Soil Mechanics (Chairman, R. E. Fadum, Department of Civil Engineering, North Carolina State College, Raleigh, North Carolina) is continuing its work, currently in cooperation with an ASTM Committee engaged in a similar task.

(4) Spencer J. Buchanan (Varisco Building, Bryan, Texas) succeeded A. W. Johnson (Highway Research Board, 2101 Constitution Avenue, Washington, D.C.) as Chairman of the Committee on Pavement Foundations.

(5) The Committee on Earth Dams (Chairman, W. G. Holtz) subdivided into five task subcommittees to handle the volume of work, plans to have some of its material in shape for presentation at the 1954 Annual Meeting of the Society.

(6) The Committee on Grouting (Chairman, R. E. Davis, 202 Engineering Materials Laboratory, University of California, Berkeley, California) subdivided into four task subcommittees, is collecting a variety of information on the different grouting processes, and plans to submit its final report in the not too distant future.

(7) The Committee on Engineering Geology (Chairman, Karl Terzaghi, Pierce Hall, Harvard University, Cambridge 38, Mass.) has been subdivided into ten task subcommittees, of which four have been formed and are at work. Formation of the remaining six will await the completion of the assignments of the first four.

(8) The Committee on Publications (Chairman, W. L. Shannon, 1055 Stuart Building, Seattle, Washington) reports action completed on twelve papers of a total of twenty-nine received during the year ending in October, 1953. The committee reports that the increase in its membership to six has speeded up the processing of papers, but that a backlog will probably continue to exist for some time.

(9) The Committee on Collaboration with Foreign Engineering Societies, having been deemed to overlap the National Council on Soil Mechanics in its objectives, has been dissolved with appropriate thanks to Chairman G. P.

Tschebotarioff (Engineering Building, Princeton University, Princeton, New Jersey) and his colleagues for their past efforts.

(10) Chairmanship of the Committee on Cooperation with Local Section Soil Committees has been assumed by F. R. Klauck (Engineering Research Laboratory, E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware), who succeeds Professor F. J. Converse (California Institute of Technology, Pasadena, California).

(11) The Committee on Session Programs will operate under the chairmanship of Stanley D. Wilson. Its objective will be to arrange, directly or, more frequently, through a local task committee, for the Division sessions at the various Society meetings.

PUBLICATION PROCEDURE FOR TECHNICAL PAPERS

The attention of all Division members is called to Separate No. 290, "Publication Procedure for Technical Papers." Compiled by the Committee on Publications of the Board of Direction and recently distributed to Society members, this pamphlet explains the current Society regulations and procedures in connection with preparing, submitting, reviewing, processing, and publishing technical papers under the Society's sponsorship.

The objective is to expedite the publication of a large volume of material in the form of Proceedings—Separates. These papers will receive a brief review by the Committee on Publications of the appropriate Division, and those not conforming to the requirements will be rejected. Subsequent selection of papers for publication in the Transactions will be made from the Proceedings—Separates in accordance with the strict standards of acceptability that have obtained in the past for all Society publications. Thus the task of the Committees on Publications will not be appreciably reduced; but the deferment of a strict review until the time for selection of Transactions papers will permit a considerable quantity of material to be brought to the attention of the profession that might formerly have been denied publication, delayed, or forced into other journals.

A NOTE TO LOCAL SOILS SECTIONS

One of the most important steps to be taken by the Newsletter in accomplishing its objectives will be to call to the attention of local Soils Sections their own important role in developing the Soil Mechanics and Foundations Division and contributing to this branch of the profession. The Soils Sections are the most logical and convenient focal points for local expression and discussion in soils engineering, and their potentialities in this respect are all the greater if information can be exchanged easily among them. The Newsletter can be of help in keeping this exchange of information fluid. Contributions are welcome at any time, and every effort will be made to answer questions.

PARTICIPATION IN DIVISION AND SOCIETY ACTIVITIES

As of January 1, 1954, the Soil Mechanics and Foundations Division, with 1355 registered members, ranks sixth in the Society in that respect.

The reviewing and processing of papers submitted for publication, the planning and conducting of technical sessions, the collecting and organizing of information by numerous committees on a wide variety of subjects, and the

maintenance of suitable technical and professional standards are a few of the many important functions performed largely within the Divisions. They all take time and they all deserve our best efforts.

We hope that one important effect of the Newsletter will be to encourage wider and more active participation of the membership in Division and Society activities. In this connection, constructive criticism of the Division or the Society is a service and contribution that we can all perform. Such criticism is invited, and we suggest the Newsletter as a convenient forum for discussion of matters in this category.

Participation in the work of the Soil Mechanics and Foundations Division is urged on all of its members as an objective that, in view of the present dynamic state of this branch of the profession, is bound to be rewarding.

EXCHANGE OF INFORMATION

Members of the Division and particularly local section soils committees are urged to keep the Division informed of their activities and of matters of general interest within the Division's province. This Newsletter is intended to provide a convenient means of distributing information of this kind, and will include all such items as a regular feature. Please send all contributions to the Secretary of the Executive Committee of the Division, Jorj O. Osterberg, Department of Civil Engineering, Northwestern University, Evanston, Illinois.

NOTES FROM THE FIELD AND LABORATORY

As another regular feature of the Newsletter, dependent upon contributions from readers, we propose to allocate a part of each issue to items of useful information from the field and laboratory. We suggest that items be held under 200 words, and plan to print them with the writer's name.

ANNOUNCEMENTS

ATLANTIC CITY CONVENTION

Chalfonte-Haddon Hall
Atlantic City, New Jersey — June 14-19, 1954

Two sessions are at present being planned for the Soil Mechanics and Foundations Division at this meeting. Preparation is already in progress under the direction of G. P. Tschebotarioff.

NEW YORK CONVENTION

Hotel Statler
New York City — October 18-22, 1954